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ABSTRACT

Important lessons can be learned from the educational programs of the military services that can be applied to civilian education. The U.S. Air Force vocational-technical training program is geared to "learning outcomes" which makes it possible to measure job entry capabilities. The Utah Department of Vocational Education studied the potential for using this type of instruction in their schools. Air Force material is developed for specific groups to attain specific performances in a prescribed condition. The criterion for successful instruction is the attainment of certain objectives. This is different from civilian instruction which lacks measurable objectives and centers more on instructional procedures rather than instructional outcomes. The selection of criterion-referenced Air Force material used, with certain additions and modifications, must be based on their success in achieving their objectives. The attitudes of teachers toward their courses and their relation to their students must change with the use of criterion-referenced curriculum. (EC)

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A SUPPLEMENT

to the

FINAL REPORT

Project No. 8-0301

Grant No. OEG-3-8-080301-0035 (085)

THE EVALUATION OF THREE U. S. AIR FORCE INSTRUCTIONAL SYSTEMS WITHIN CIVILIAN EDUCATION

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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by

James H. Straubel

Aerospace Education Foundation

Washington, D. C.

March 31, 1970

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PREFACE

President Nixon, on March 3, in his special message to Congress on educational reform, called for "a new reality in American education."

This "new reality," he made clear, must focus on "the actual amount of learning that takes place in a school." In measuring education's effectiveness, he said, all other considerations -- facilities, teacher standards, pupil-teacher ratios, etc. -- are over-shadowed by the answers one gets to the simple question: "What do the children learn?" American education, he stated, must be based on "the outcome of schooling."

Education geared to instructional outcomes, rather than to classic "school characteristics," makes necessary, the President noted, "responsible open measurement of how well the educational process is working." Further, he added, it leads to a system whereby administrators and teachers not only are considered responsible for what their students learn, but are held accountable for it.

These elements of the educational reform called for by the President are basic to this report, as they were to the study which prompted it.

* * *

To achieve educational reform based on measurable learning outcomes it undoubtedly will be necessary, as the President stated, "to develop broader and more sensitive measurements of learning than we now have." And in this context he noted certain current "immeasurables" such as responsibility, wit and humanism.

Without debating the latter issue, some known "measurables" deserve equal mention. For example, a wide range of vocational-technical skill areas where results most often relate to hands-on performance. Here the learning outcomes are, for the most part, self-evident, and can be rather easily measured.

Measurement and validation of learning outcomes relating to job skills can only come, realistically, from the "user" -- the employer. Only he can provide the job entry requirements on which curriculum development

should be based. From him we may require the feedback of supplementary information to fill gaps in the instructional design process. Out of this cross-feeding of information will come the documentation -- for instructional purposes -- of specific performance objectives.

If educational reform centered in measurable learning outcomes includes a system within which administrators and teachers actually are held accountable for learning outcomes, the importance of performance objectives is even more enhanced.

Legally, and ethically, one can be held accountable for his actions only if he knows in advance what those actions might involve -- not merely in broad generalities, wide open to interpretation, but in precise terms. A legal contract, for example, usually describes in detail what performance is required of the parties involved. It logically follows that accountability in education must be based on pre-determined and specifically prescribed performance objectices. Administrators and teachers must insist on this for their own protection.

* * *

Another element of the President's reform message is pertinent to this report. While expressing the need for a new approach to educational research, the President indicated a desire to seek out methods and programs, already in existence, which have proved their worth in terms of learning outcomes.

A vast resource of educational programs developed by the military services for their own use, but directly applicable to civilian education, must be considered in this category.

In the U. S. Air Force, at least, vocational-technical training has for years been geared to "learning outcomes." Open measurement of learning results has become routine. Constant feedback from the "employer" (the manpower using agencies in the Air Force) is an integral part of the educational process, and this makes it possible to measure and validate job entry capabilities. The Air Force training establishment is held accountable for regularly delivering graduates with acceptable job entry performance

to a degree rarely heard of in civilian life. And all Air Force courses -- covering a wide spectrum of skill areas -- are based on pre-determined and specified performance objectives. Hence, the Air Force has, in practice, with a vast backlog of experience, the basic elements of the educational reform called for by the President.

A great majority (some estimates: as high as 90%) of Air Force career categories involving vocational-technical skills have close job entry parallels in civilian life. Thus, in exploring Air Force training experience we are dealing not merely with military careers but also with civilian job entry requirements. Air Force experience in "learning outcome" education offers model after model of concepts, techniques and materials that have proved their worth -- that are readily adaptable to civilian use. If educational reform, as outlined, is to come, these models can serve as important money-saving, time-saving building blocks.

Indeed, if educational reform is to take place in a tight money market, educational wheels can no longer be re-invented, as too often has been the case. Huge research investments are being made in educational areas which the military has explored and tapped years before. Performance objectives are created from scratch at great expense while paralleling sets of objectives -- tested and validated -- already are operational in military classrooms. Relatively simple adaptations of military-developed course materials, rather than the creation of new materials, could save countless dollars and research man hours. Investigation of the military's resources as a prerequisite to the approval of civilian research projects, would be in the national interest. These resources include, not only teaching practices and course materials, but, perhaps more important, management concepts and techniques developed to support instructional systems based on "learning outcomes."

* * *

The study on which this report is based brought these conclusions into focus. The report bears down on the important first step which must be taken by any school system which would practice "learning outcome" education.

That important first step: coming to grips with what it intends to achieve -- with performance objectives.

During the experiment in Utah, on which this report is based, teachers became exposed for the first time to courses (Air Force) based on specified performance objectives. In a sense, they were asked to be accountable, in terms of the job entry capabilities of their graduates, to the employers they presumably were serving. Their reaction to the experience, and their action to meet the challenge, is covered in this report.

If "learning outcome" education is to move forward, there is good reason to believe that many thousands of teachers will face the same challenge: teaching in a new result-oriented atmosphere, with their own broad goals for student behavior replaced by specific objectives for student performance. And beyond that, the challenge to recognize that this new way of life in the classroom actually elevates the teacher from the role of instructor to the more responsible, more creative, more effective role of instructor-manager.

Our experiment in Utah merely scratched the surface of this subject -- for it is a broad surface, indeed. But scratch it, it did. And the experience may be a start toward an understanding of what must come -- if true educational reform is to be realized.

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I. SUMMARY

Background: This report supplements the Final Report (Project No. 8-0301, USOE) for the study titled "The Evaluation of Three U. S. Air Force Instructional Systems Within Civilian Education." That study examined three U. S. Air Force instructional systems (segments of electronics, pneudraulics and nurses aide courses) in terms of their usefulness in the Utah school system, and projected their potential usefulness nationally. Results were positive in all areas. But during the study it became evident that the Air Force materials were not being used under optimal conditions, leaving reason to believe they could be used even more effectively. Of particular importance was the relationship of specific performance objectives, as used by the Air Force, to the broader goals of the conventional educator. All this gave rise to this special report.

Scope of Report: Basic guidelines are presented for introduction of criterion-referenced materials, as represented by those of the Air Force, into the civilian classroom. The criterion-referenced approach is compared with the traditional approach which is followed by suggestions for selection, preparation for use and use of criterion-referenced materials.

Recommendation: That practical guidelines for teachers be formulated to implement criterion-referenced courses in vocational-skill areas, drawing fully on procedures developed and collected by the U. S. Air Force, and on other sources -- such guidelines to provide step-by-step instructions for classroom use.

GUIDELINES FOR INTRODUCING
LEARNING OUTCOME INSTRUCTION

by

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II. INTRODUCTION

The U. S. Air Force, in recent years, has mounted a massive and pioneering effort in developing instructional systems, including some 5000 hours of programmed materials, with each course designed to achieve at least the outcomes that are specified in advance.

Sensing the potential usefulness of this instruction in civilian schools, the Bureau of Research, U. S. Office of Education funded a project to permit the Utah Department of Vocational Education and the Aerospace Education Foundation to explore this potential.

(See Final Report, Project No. 8-0301, Grant No. OEG-3-8-080301-0035 (085), "The Evaluation of Three U. S. Air Force Instructional Systems Within Civilian Education," December 31, 1969).

The resulting 18-months study addressed itself primarily to these two basic questions:

1. Is it feasible to use Air Force instructional materials in civilian schools in the state of Utah?

2. If it appears feasible in Utah, how likely is it that it will be as feasible elsewhere?

In the study, Utah instructors offered segments of three different Air Force courses (which they selected), using procedures as similar as possible to those set out by the Air Force. Student performance in these segments was then compared with that of students receiving conventional instruction. Information also was gathered on the modifications required of Air Force materials, and on the reactions of students and instructors to such materials. Used in the study were:

1. A 90-hour segment from the Electronic Principles course;

2. A 60-hour segment from the Aircraft Pneudraulics course;

3. A 20-hour segment from the Medical Service Specialist course.

The electronic segment was taught at five schools, each of the other two segments at a single school.

As indicated in the Final Report, the results were highly encouraging. Students using Air Force procedures and materials performed at least as well as those taking the standard course, or significantly better, and generally in less time. The amount of modification required to adapt the Air Force materials to civilian use was not excessive. Perhaps even more significantly, instructors have continued to use the Air Force materials in preference to their own, and the Utah Department of Vocational Education has proposed for adoption on a state-wide basis the objectives of the electronics course segment.

The success of the Utah study seems to confirm the belief that Air Force course materials can be used successfully in a civilian environment. More than that, since the materials were not used under optimal conditions, there is good reason to believe that their use can be made even more effective than they were during the study. This prediction is based upon identification by investigators of a number of factors that probably depressed both the potential effectiveness of the Air Force materials (as defined by student achievement) and their efficiency (as measured by performance gain per unit time). It did not seem appropriate to explore these factors in depth in the report of the main study, but since they bear on the question of how to make the most effective use of Air Force materials, they are described herein.

This report is the result of many spin-offs from the main study, as it progressed; it is based on several follow-on workshops with instructors engaged in the Utah project, on personal interviews with Utah teachers and administrators, and numerous meetings with Air Force training specialists.

This report offers basic guidelines for the introduction of criterion-referenced materials, as represented by those of the Air Force, into the civilian classroom. These guidelines are based on the experience gained in the recently completed research project in Utah, referred to earlier in this report, on interviews with Utah administrators and instructors and on other related experiences. The report begins by describing the

criterion-referenced Air Force materials and comparing and contrasting them with conventional instruction materials in an attempt to furnish the reader some perspective on this matter. The report then offers suggestions on the following: selection of the materials, preparation for use and actual use of criterion-referenced materials giving consideration to teacher attitudes and teacher orientation.

III. AIR FORCE MATERIALS: AN OVERVIEW

Description

The expression "Air Force materials" as used in the present context, needs some clarification. The many charts, drawings, mock-ups, and simulators developed as training aids for the Air Force instructor are not necessarily a part of the materials referred to here.

The materials under discussion are criterion-referenced. That is, they are developed to help a relatively specific target population attain pre-specified criteria of performance when used according to prescribed conditions. During development, the materials are tested for effectiveness and amended as necessary until they perform satisfactorily. When they are used as prescribed, there is a high probability that the desired results will be achieved.

Thus -- and this is the important distinction -- the Air Force materials are not simply aids used to supplement the efforts of an instructor. Instead, the materials themselves are the essence of the course. Plainly, this changes the role of the instructor. Instead of being the major source of information, as in a conventional course, the instructor has the no less important or less difficult tasks of managing instruction (seeing that the right materials reach the right students at the right time) and of diagnosis and remediation (finding the problems of individual students and taking appropriate steps to solve them). With the instructor spending less time transmitting information, he has more time for decision-making on instructional procedures, and more time to serve as a consultant to students who deserve personal attention. Thus, he is more intimately aware of individual needs. And with classroom progress controlled by student performance, rather than time-controlled, the instructor holds a tighter rein over what happens in the classroom.

The nature of the materials varies. They include videotapes and motion picture films, programmed textbooks, workbooks, and instructional devices.

Development

The development of these materials differs considerably from the development of materials intended simply to assist an instructor or to provide practice. In the first place, before instructional development begins, a serious attempt is made to identify the performance expected of the

proficient student. These objectives describe the end-product of instruction, the performance expected of the proficient student. Where appropriate, they also describe the conditions under which the performance will be expected to occur and the criterion of acceptable performance. The objectives thus provide the basis for deciding what to teach and how to tell when teaching has been successful.

Once objectives have been defined, a test is designed for determining whether the objectives have been achieved. This instrument, typically referred to as a criterion test, includes whatever items are relevant for assessing achievement of each objective. Since the criterion test is designed to determine whether an objective has been achieved, questions usually asked during the development of test items -- whether the item has a particular level of difficulty or whether the responses of a group of students are normally distributed -- become irrelevant. What is relevant is only whether the test assesses the intent of the objective and whether it is clear to the student -- no more and no less.

With the objectives and a test instrument available, instruction is prepared in draft form and then, using members of the target population, the instruction is tested and revised as many times as necessary to ensure the desired outcomes.

Classroom Use

When such criterion-referenced materials are used, a rather different philosophy prevails than in the traditional classroom. In essence, the instructor becomes the ally of the student, helping him achieve the objectives of the course, regardless of who specified these objectives. Ideally, of course, each student would proceed at his own pace, taking as long as he needed to complete a segment of instruction. With a few exceptions, the Air Force procedure does not go quite this far. Typically, the practice is to use a group-paced technique wherein all students are exposed to the material at the same time. Even so, the object is still to instruct so that the criteria are attained by as many students as possible.

In summary, Air Force materials of the type under discussion are developed according to criterion-referenced procedures calling for development and testing of materials until they result in the student performance specified in the objectives.

IV. TRADITIONAL INSTRUCTION

Most instruction, whether military or civilian, marches to a different drummer. Though an experienced instructor may have his broad goals fairly well in mind, he tends not to translate those goals into objectives which specify his intended outcomes in terms of student performance. Hence he cannot design his instruction to achieve those outcomes effectively and consistently.

The usual procedure is for the instructor to prepare lesson plans outlining the content he wishes to cover and identifying the instructional aids he intends to use. Because schools seem designed more for administrative convenience than for maximizing student learning, the instructor is constrained to instruct for fixed periods of time. He lectures, demonstrates, discusses, or asks students to complete laboratory exercises. Periodically, he administers an examination in which, using a sampling technique, he tries to determine how much of what he has taught has been learned by the students. These examinations are scored and grades are assigned on a norm-referenced basis, that is, a few of the highest scoring students are assigned the highest grade, the next highest scoring group of students is assigned the next grade, and so on. Though such a scoring system reveals which students happen to perform better than their chance neighbors, it reveals little about whether any student can perform as desired. Though the system can rank students on the basis of their ability to respond appropriately to the items, it reveals nothing about the number of students who can perform according to a standard of acceptable performance.

Typically, the instructor in such a system works from textbooks and lesson plans. He measures his performance in terms of content covered and hence feels no need to have his intended outcomes written down in the form of objectives. Because he does not have measurable objectives, he cannot have a criterion examination based on objectives. He could, if pressed, describe the essential characteristics of his students as they influence his instruction and their ability to learn, but probably has never committed this information to writing. He cannot tell how effective his instruction is since this requires the administering of a criterion examination both before and after instruction. This instructor tends to think more in terms of instructional procedures (what he intends to do to his students) rather than in terms of instructional outcomes (what he intends for the students to be able to do as a result of his instruction).

V. THE UTAH EXPERIENCE

Initially, in the Utah study, the instructors involved apparently felt that because they were experienced at instructing in a conventional setting they understood the Air Force instructional objectives with which they were working. Further, they tended to behave as though the content headings in their lesson plans were the same as instructional objectives. As a result, they compared the specific statements of objectives associated with Air Force materials with items of content included in their own courses, a comparison not of outcome with outcome but of outcome with procedure. It was only while the course was in progress that the instructors came to realize that outcome statements and process statements differ substantially and that they had not fully appreciated the implications of Air Force objectives.

On completion of the experiment, most instructors interviewed urged that if Air Force materials are again made available, steps should be taken to insure that instructors understand the nature of an instructional objective and its implications. One or two instructors went so far as to suggest that such materials should be made available only to instructors who have written measurable objectives on their courses with which to appraise the relevance of the new materials. They pointed out that if an instructor relies on these materials to do the entire teaching job when, in fact, the objectives of the materials are not the same as his, he will be disappointed in the outcome and be inclined to conclude that the new materials and procedures are not satisfactory.

Out of workshop sessions and personal interviews came the definite conclusion that, in designing for most effective use of Air Force materials, special attention must be given to instructional objectives. Conditions must be arranged so that instructors considering the use of Air Force courses will understand the extent and limitations of these materials.

An instructor who is not knowledgeable about the implications of objectives is hard pressed to make sound decisions about procedure. For example, when he is confused about the difference between means (content) and ends (objectives), he tends to make decisions on the basis of a content comparison; that is, he will tend to conclude that Air Force materials are somehow lacking if they do not cover the same content as his own course. Often, less or different content is needed to achieve a given

objective than is used by an instructor, but unless he recognizes this he may find Air Force materials wanting. In the Utah study, for example, instructors of the electronics course concluded that the sub-course in Direct Current developed by the Air Force matched their own intent except in the area of mathematics. It was their judgment that they had to teach more mathematics than was taught in the Air Force sub-course to reach their Direct Current objectives. For this reason, they decided to add mathematics instruction to the Direct Current sub-course.

In fact, students completing the unaugmented Air Force course performed significantly better than those completing the regular course, despite their lack of the additional mathematics. It is clear that the added mathematics was not relevant to achievement of the objectives for the Air Force Direct Current sub-course. In a workshop session following the Utah study, the electronics instructors acknowledged that the additional mathematics was relevant to achievement only in the Alternating Current sub-course to which students were assigned following the Direct Current segment. Traditionally, a mathematics sub-course is taught in a block before electronics theory, even though this mathematics segment is not required for the sub-course that immediately follows it.

Objectives

Conflicts in objectives also were apparent in the aircraft maintenance portion of the experiment. Initially, Utah teachers selected the Wheels, Tires and Brakes segment of the Air Force Aircraft Mechanics course taught at Sheppard Air Force Base, Texas. A number of problems arose, the major one being the lack of training equipment in Utah comparable to Air Force equipment used in teaching the course. Another: high adaptation costs. Therefore, the Pneudraulics Repairmen course at Chanute Air Force Base was offered as a reasonable alternative. This course was accepted, although only one-third of the equipment specified for the course could be obtained from surplus sources. Equipment problems like these are beyond control. Other problems are not. For example, without precise objectives to guide them, the Utah teachers estimated that the scope of their own pneudraulics course was somewhere between the 3-level and 7-level of the Air Force course. Therefore, extra effort was required to interweave the lessons' plans for the two levels. This also affected the interweaving of the tests at these levels. Then, materials from the Air University had to be added to cover information not found in the course for pneudraulics repairmen.

Only after the course had been designed and placed in the school system was it determined that a different level Air Force course would have been more effective. In retrospect: had the course objectives been spelled out clearly, an Air Force officers' course for pneudraulics' supervisors, rather than an enlisted men's course for pneudraulics repairmen, would have been offered the Utah instructors, and would have met the requirements.

Yet, a comparison of objectives is only a part of course selection. Even where there is congruence between civilian and Air Force sets of objectives, it may be that more equipment or more course modification is required than is practical.

Equipment Needs

The equipment problem was revealed early in the feasibility study when Utah instructors were reviewing potential Air Force courses. One course was rejected specifically because the cost of equipment associated with the instruction simply could not be borne by the school. Fortunately, this appears to be an issue that should pose no particular problem if a detailed equipment list is attached to every Air Force sub-course under consideration. A school can then readily compare the required materials with a list of what it can make available.

Modification

The question of modification is less simple. In the case of the electronics sub-course selected for the Utah experiment, no modifications of the content or structure of the materials were considered necessary. Because closed-circuit television was not available in the Salt Lake City schools, however, the Air Force videotapes associated with the Direct Current sub-course had to be converted into motion picture film. The cost to produce one film copy of each videotape, while quite high, was not indicative of the unit cost with a reasonable volume requirement.

Modification may have to be made in the content of the materials. Generally, as with the medical specialist course, instructors can be expected to decide that certain military terminology should be modified to civilian terminology. Another example of a potential materials modification was provided by the electronics sub-course. Instructors reported that the films provided overly long

pauses for students to write responses in their guides. They suggested that substantially shorter pauses would have made the films more interesting without damaging their effectiveness.

VI. SELECTION OF THE MATERIALS

Effective use of instructional materials must be preceded by effective selection.

In the process of selection, these basic questions should be asked:

1. Will these materials do all or some part of what I want to accomplish?

2. Is it feasible to use them as directed by the developer?

3. How effective are they if used according to directions?

4. How must these materials be modified to make them useful or workable in my instructional environment? Considering the time, money, and facilities needed, is modification feasible?

Given the appropriate tools, answers to these questions are not difficult to determine. The problem is the absence of the "appropriate tools." And their absence is the heart of the problem of selection. There are some conditions that must be met from both sides of the fence.

First, the teacher must have written out:

1. Objectives describing in measurable terms the performance expected of a proficient student;

2. A description of the target population (available students);

3. A measure of how effective his own instruction is in achieving his objectives.

(The last can be obtained only if he also has a criterion test which is based completely and exclusively on his objectives.)

Then the developer of the instructional materials must provide similar information so that a comparison can be made.

To the degree that this information is lacking on the part of either the instructor or the developer, the decision about the utility of the materials in the new

setting becomes more difficult. Good selection is dependent upon both instructor and developer providing precise information about objectives, target population, and instructional effectiveness. Implicit in that statement is a large part of the answer to the question of how to make the most effective use of any new materials.

Unfortunately, it is seldom that all of the information needed for good selection is available. Instructors and developers are equally culpable in this. And since the situation is not one to be remedied overnight, the problem is, as usual, one of determining how to make the best use of an imperfect world.

To select instructional materials intelligently one must first have instructional objectives which state explicitly the kinds of desired student performance. Given objectives, the instructor should be able to select instructional procedures and content that will facilitate achievement of those objectives. Without such objectives, he can only operate in a fog of his own making.

A school considering the use of criterion-referenced Air Force materials must initially ask itself, "How well are the objectives spelled out for the course as it is currently taught?" If the objectives are written in performance terms and if those objectives are based on some form of task analysis and projection to insure their importance, then it is reasonable to move to the next step, that of selection.

If, on the other hand, the instructional intents are not well defined -- that is, if instructors protest that "We know what we want to teach" but cannot produce a written statement of the desired outcomes -- then additional steps must be taken before potential materials are reviewed. Exactly which steps are indicated depends primarily upon the way an institution makes decisions about curriculum. If individual instructors are allowed to make all decisions about the outcomes of instruction, then all instructors must be schooled in procedures such as task analysis and the preparation of instructional objectives. If, on the other hand, a team of specialists has responsibility for identifying the desired outcomes, then a different and simpler route can be followed.

The Utah experience is instructive in this regard. It became apparent that the instructors charged with reviewing Air Force materials could not, in most cases, say precisely what performance outcomes they wanted of

their students, and further, they could not say for sure what skills were relevant to the kinds of jobs likely to be available to the young men they were training.

It would be a mistake to conclude that the Utah instructors were in some way less competent than their peers, however. Instructors tend to teach as they themselves were taught and in a fashion that is acceptable to their parent institutions and to the educational community. Since teachers are no more exempt from the laws of behavior than anyone else, they tend to do those things that lead to positive consequences and avoid doing those things that lead to no consequences or to aversive consequences.

In the educational system as currently operated, it is clear that the consequences related to effective instruction are usually few. The system simply does not revere results that are defined in terms of student performance. Generally, the rewards of the system (salary, promotion, status) are dispensed not for effective instruction but for the number of months served and for the number of credits earned. Thus, the instructor who has served longest with an institution tends to be highest on the salary scale, regardless of how successful he is in facilitating desired student performance. In such a situation it is not reasonable to expect instructors to behave much differently than they do.

Before teachers will accept the idea of student performance as the primary object of instruction, there must be a climate of acceptance for such a viewpoint. Specifically this means that the administrators must be favorably disposed toward it, capable of identifying teachers who are behaving appropriately from those who are not, and willing to make favorable consequences contingent upon such activity. The administrator must revere an instructor's output (as measured by the extent and direction of student performance) more than he reveres what is taking place in the instructor's classroom. The administrator who is unaware of the criterion-referenced approach to instruction is, through word and deed, likely to punish instructors inadvertently for trying to use it, thus influencing the teacher to abandon his attempt to change drastically his mode of instruction.

Experience indicates that it is not enough for an administrator merely to be aware of and open-minded about the criterion-referenced approach. If he is to influence

his faculty in that direction, it is imperative that he demonstrates active enthusiasm in the new approach, that he motivates his staff to shift their frame of reference, and make it clear that he will sustain them in the many setbacks and pitfalls that lie ahead. Those who conduct teacher training workshops in the preparation and use of instructional objectives report that it is not difficult to convince the teacher of the logic and humanity of the approach. And, within a day or two, it is possible to impart enough skill and motivation to actually influence the teacher to try to write objectives. But implementation of the criterion-referenced approach to instruction calls for more than a brief in-service workshop. It takes time to develop the habits of thinking associated with the new approach.

This discussion is not intended to imply that teachers and administrators need inordinate preparation before they can effectively use criterion-referenced materials such as those developed by the Air Force, or that these new materials would be of no value to instructors teaching in the traditional manner. The point is that the true effectiveness of such materials is dependent upon an instructor who understands and applies the criterion-referenced approach.

Now let's review the four basic questions we said should be asked in the selection of criterion-referenced materials.

1. Will these materials do all or some part of what the instructor wants to accomplish?

The basic procedure for answering the question is to compare, item by item, the objectives of the desired course and those of the proposed material. Objectives are specified for each validated course prepared by the Air Force and if an instructor has objectives for his own course, regardless of who prepared them, a comparison is relatively straightforward. The degree of overlap can be readily determined and if objectives are rank ordered in terms of importance even more information can be developed regarding the relevance of the proposed materials.

On the other hand, if Air Force materials are used at institutions where course objectives are not stated in a manner which will allow comparison, it is likely that instructors will compare lesson plan content with Air Force outcome statements, and make less than optimal decisions. As pointed out by the Utah instructors, a

teacher who selects a criterion-referenced course will tend to rely on it to do the bulk of the teaching job. When he discovers that it does not in fact do the entire job (even though no one claimed it could do so) he is likely to blame the materials for his failure. More important, he is likely to become not only disenchanted with but confused about criterion-referenced instruction itself.

2. Is it feasible to use the materials as directed by the developer?

Though new materials may be appropriate and feasible from the standpoint of cost and ease of modification, they may still be unusable by a particular school. In the Air Force electronics sub-course tested in Utah, for example, the recommended procedure is to use a series of motion pictures as the primary means for explaining the subject material. As he watches a film, the student is expected to write responses to questions in a workbook. The instructor's prime functions are to ensure that the films are seen at the proper times, to answer questions, and to help students. He is no longer a lecturer; instead, he is a manager and a consultant. If a particular institution does not allow an instructor to operate in this manner, then validated courses like those of the Air Force are again contraindicated.

To determine whether the recommended practices are feasible:

1. Identify the procedures recommended by the developer. (If they have not been described explicitly, it will be necessary to observe the materials being used, or confer with the developer).

2. Have potential instructors indicate whether they are willing to follow the recommended procedures.

3. Have administrators indicate whether they are willing for their instructors to follow the recommended procedures.

3. How effective are these materials if used according to directions?

It has to be stressed here that the effectiveness of any instructional material cannot be assessed merely by inspection or by analysis of the structure or content.

If Air Force materials are accompanied by validation data, then their potential effectiveness in a new environment is predictable, provided the target populations match and provided the materials are used according to

directions. If validation data are not available or if the conditions regarding target population or proper use cannot be met, then the only reliable way to determine effectiveness is by actually trying them out on a sample of one's own target population.

Questions about how much better the new materials might be than traditional materials are probably unanswerable, given the procedures employed in most schools. An answer requires comparative data about the effectiveness of both the existing course and the validated materials. If such information is available for the latter, but not for the former, as generally is the case, the question "What can be expected in the way of improved student performance?" makes little sense in this context and should be deleted in any consideration of new materials.

4. How must these materials be modified to make them useful or workable in the new instructional environment? Is modification feasible?

Even though a set of materials may be completely appropriate in that the objectives match those of the instructor, it may well be that it is not feasible to use those materials. They may need too much equipment or space, for example, or perhaps it would take too much effort to modify them. This would clearly be the case if, say, the school had to supply large and complicated mock-ups or simulators, or if costly modifications were required.

Modification and Cost Feasibility

Based on experience with the Utah project, the procedure recommended for determining modification and cost feasibility is as follows:

A. Having identified one or more sub-courses as the result of an objectives' comparison, identify the equipment and materials required for instruction associated with the objectives.

B. Calculate the cost of required equipment and materials not currently available at the school.

C. If additional equipment is required, determine whether suitable space and power are, or can be made, available.

D. Review the materials and identify concepts and terminology considered inappropriate for school use.

E. Assess the importance of deleting inappropriate concepts and terminology. This can be most handily accomplished by asking, "What is the probable consequence of leaving them where they are?"

F. For concepts and terminology judged detrimental, estimate the cost of deleting them.

Only if both instructors and administrators are willing to carry out the instruction as designed can the use of the materials be considered feasible. If either instructors or administrators are reluctant, the materials should not be used, for they are sure to fail in such circumstances.

In the real world there are, of course, degrees of feasibility. The issues are not as clear-cut as this report may make them sound. The practice of instruction is still far from being a science, even when the methods used in the preparation of criterion-referenced materials have removed some of the margin for doubt. This being the case, it is relevant to speculate as to how much one can deviate from recommended procedures in criterion-referenced material before results begin to be degraded.

More specifically, is it not possible to use Air Force materials in ways different from those recommended and still get good results? The answer, of course, depends on what is meant by "good results." As was seen in the main study, the procedures followed only approximated those recommended by the materials' developers. Even so, students using these materials performed at least as well or better than those exposed to the traditional instruction. As can be seen from the post-test results, however, to attain performance that is as good as traditional instruction is hardly an achievement. Criterion-referenced courses, as developed by the Air Force, were designed on this premise: That unless a high percentage of students accepted for a course (80 per cent or more) perform as prescribed by the objectives, the instruction must be counted a failure. If instruction has been validated for a particular target population, and if members of that target population have been admitted to the course and non-members selected out, instruction should achieve whatever results were achieved during field testing of the materials.

VII. PREPARATIONS FOR USE

Most of the preparation steps have been implied in the previous section of this paper and do not require much more in the way of explanation. If additional equipment is required that equipment must be procured and available before the course begins. If materials must be modified, the indicated modification should be completed during the preparation stage.

In addition to the obvious preparation steps, a few recommendations are in order with regard to instructor preparation:

1. Instructors should be briefed on the extent and limitations of the Air Force objectives as they compare with those of the course to be taught. They should be reminded immediately before the course begins about any content and activities to be added to meet the course objectives. They also need to be reminded about which objectives the materials are likely to achieve without much help.

2. Instructors should be briefed on the essential procedures to be followed. The preferred technique is for both the instructors and their administrators to review the procedures and the ways in which it is possible to tell whether the procedures are being followed. This makes it more likely that administrators will not inadvertently penalize instructors for carrying out procedures which may be foreign to the school but which are appropriate for the materials being used.

3. Probably the most important step is to review the procedures to be used for evaluating students. It is in this area that the largest discrepancy exists between current practice and criterion-referenced practice. As previously mentioned, standard practice is to give examinations consisting of items which sample coverage of the materials taught, assigning grades on the basis of how well the individual student performs in relation to his happenstance neighbor. Evaluation in a criterion-referenced course is carried out differently. The examination is strictly keyed to the objectives and grades are assigned (if assigned at all) on the basis of how well

the individual achieved the assigned objectives. With such a system it is quite possible for most or all of the students to achieve as desired, in which case it is mandatory that they receive the highest grade. If the administration of an institution is not willing for students to be evaluated for achievement on these terms, this fact should be well understood before criterion-referenced instruction is undertaken.

VIII. USE OF THE MATERIALS

Flexibility is the key to using criterion-referenced materials. Unlike a traditional course, in which time is fixed and the amount of learning is variable, a criterion-referenced course continues as long as necessary to achieve the desired outcomes -- in other words, the amount of learning is fixed and time is variable. To operate successfully, the instructor must keep his eye on the objectives. He must remember that his function is to help the student achieve the objectives, using the materials available.

Instructor Guidance

To increase the probability that materials are used under favorable conditions it is recommended that instructors have periodic access to those more experienced with the procedures. The effectiveness of consultants has been established in other projects where instructors have been expected to introduce novel instructional techniques. For example, during the early implementation of Project PLAN, a comprehensive individualized instructional system for grades 1 - 12, it was clear to the developers that a one-week workshop in the individualized procedures was not sufficient to cause teachers to implement the system as designed. Frequent, regular visits from a field consultant, however, rapidly increased the teachers' ability to solve minor problems and to perform as desired. In Project READ, a programmed course in reading for ghetto youngsters, a large part of its success is attributed to the consultants and aides made available to the teacher using the new materials.

Organization

A number of procedural matters which have some bearing on the use of Air Force materials came to light during the Utah study. For one thing, instructors pointed out the importance of "organization," emphasizing the need to have all materials in the right place at the right time and to have classrooms available on schedule. For those unfamiliar with the school scene this may seem to be a point too obvious to mention. It is not a trivial problem, however. In public schools, it is not uncommon to juggle the assignment of classrooms during a semester. While this may be a small problem for an instructor who has merely to move a textbook and a piece of chalk from one room to another, it poses a severe problem for the

instructor who must move a great deal of material and equipment. Instructors participating in the Utah experiment recommended that Air Force materials be used only by institutions willing to make firm commitments for space and facilities. As they pointed out, a lapse in these matters is far more visible and upsetting to the student when the course is highly organized and carefully sequenced, as is the case with the Air Force courses.

Instructor Attitudes

Another issue in this general category concerns the attitude of instructors. It is well known that a student's attitude is significantly influenced by the attitude of his instructor; if the instructor models apathy or dislike toward his subject matter or the materials he is using, it is likely that his students will adopt a similar stance. The Utah instructors were sensitive to the importance of the instructor being favorably disposed toward his topic and his procedures. They recommended that administrators be urged to refrain from requiring an instructor to use Air Force materials if he is not disposed to do so.

Indeed, at the outset of the experiment, several Utah instructors were highly skeptical of the prospects of introducing Air Force materials into their classrooms -- not from an anti-military standpoint (the Air Force is the largest employer in the state) but with regard to the new instructional approaches involved, and the forthcoming evaluation of old vs. new. On this latter point, particularly, the skepticism could well be understood. In each subject area under study, the instructors involved had played major roles in the development of the conventional course. Air Force techniques and course materials were, in effect, being placed in competition with "my course." For this reason alone, adaptations to Air Force materials were encouraged, and ultimately instructors found personal identification with the Air Force course segments.

A good example of this trend was evident in the electronics portion of the experiment. The conventional course was the traditional lecture course with some discussion sessions, and with no visual aids. The Air Force course was entirely film-based, supported by student study guides and workbooks. During pauses in the film showings, students were expected to answer questions in their workbooks.

Some instructors, apparently feeling they had been replaced by strips of celluloid, were inclined to open a

class session with a remark such as: "Well, here's some Mickey Mouse for you, but that's what the program calls for." Yet, by the end of the experiment, the electronics teachers, accepting the visual-oriented Air Force course as superior to their own, acted and spoke like instructor-managers as they offered these recommendations for implementing film-based instruction:

1. To increase the probability that students will follow instructions and make active responses as they watch filmed sequences, instruct them to fill out the response books and tell them that you will be looking at their books.

2. Use the film to introduce a new topic rather than to review it. Introduce the film yourself before showing it.

3. If you are working in a room that is quite dark when the shades are drawn and the lights are out for screening a film, a single spotlight aimed at a corner of the room will provide enough light for students to write in their TVI Guides.

4. Stop the film occasionally to change the pace and to augment explanations where you feel this may be helpful.

5. At the beginning of the course, tell the students how and why the films were prepared. This brief procedure should increase the student's acceptance of the films.

Utah instructors in all three subject areas under study agreed in the superiority of the Air Force course segments, to the extent that, at their initiative, these segments have become part of the regular curriculum.

In this connection, the Chief Nurse in charge of the nurse's aide course deserves special mention. At the outset, she was perhaps the most outspoken of the instructors in questioning the use of Air Force materials. At the end of the experiment she not only favored these materials, but spent her own time, after school hours, doing adaptations so the Air Force course segment could be integrated into the regular curriculum in time to meet scheduling deadlines for the following semester. In so doing, she was making an extra effort to replace a course unit she personally had developed.

It is pertinent to note, in assessing these teacher attitudes, that the quality of materials was not necessarily a determining factor. In fact, student surveys revealed (and teacher interviews confirmed) that the Air Force films used were not judged to be high in quality of content; some students said some films were "boring." Yet, both students and teachers favored the film-based instruction over conventional lecture-discussion sessions.

The use of visual aids in itself (quite apart from film quality considerations) was regarded as a positive factor. But more important, both teachers and students seemed to be reacting favorably to a new way of life in the classroom -- even though they were getting only a taste of what that way of life was meant to be under the "learning outcome" instruction system which produced it.

IX. AN APPRAISAL -- FOR FUTURES

In moving from conventional to criterion-referenced curricula, teacher attitude probably is the single most important factor in measuring success or failure of the endeavor.

Additional to the teacher reactions already covered, and as noted in the basic report, this teacher-centered activity has taken place in Utah:

* Many project teachers voluntarily updated themselves with literature on the application of performance objectives to classroom procedure.

* Midway in the experiment, selected teachers participated in a workshop, sponsored by project investigators, which confirmed the need for closer school-employer relationship to more precisely establish job-entry requirements.

* To fill this gap, selected teachers participated in a two-week workshop with union and industry representatives to establish these requirements and relate them to classroom experience. This was the first step toward development of an "articulated curriculum" linking high school and post-secondary electronic courses in the state.

* Selected teachers participated in a summer workshop (1969) to help prepare, for the above effort, a compendium titled "Articulated Guide for Secondary and Post-Secondary Vocational Electronics." (Copy of Guide included in Appendix).

* Teachers throughout the state, in every school offering electronics courses, have participated in the evaluation of the Guide -- which essentially is a compendium of the performance objectives for the Alternating Current segment of the Air Force electronics course, used in the Utah study, plus the Direct Current segment of the same course -- both modified (and improved) by the summer workshop group mentioned above.

* Teacher reaction to the acceptance of the AC-DC teaching package, as presented in the Guide, and modified to meet individual teacher requirements, is very positive, according to Utah state vocational authorities.

* Teachers in selected schools are classroom-testing the AC segment of the electronics course, and are preparing to test for classroom use other criterion-referenced Air Force courses, including solid state devices and computer programming, as requested by state authorities.

* * *

The above is reported, not merely to review the type of teacher activity generated by the Utah study, but to place into sharper focus a movement from conventional to criterion-referenced instruction among teachers who, when first exposed, greeted the latter with neutral or skeptical attitudes.

The question arises: Are Utah teachers acceptable models for a movement toward "learning outcome" instruction?

First off, as noted in the basic report, there is every reason to believe that they are a representative group of vocational-technical teachers. At the same time, it must be stressed that the Utah teaching community had vigorous administrative support for the study and the follow-on activity -- from the state superintendent of schools on down -- plus strong leadership at the state vocational level. Such support was essential to the success of the project -- and will be, as noted earlier, in any similar move away from conventional classroom practice.

In turn, the administrators were motivated by manpower studies which revealed a need for change in the Utah vocational curriculum -- if Utah was to keep pace with technological advances related to industrial employment. State government, therefore, was motivated by the need to retain industry in Utah and attract new industry to Utah -- as each year thousands of its skilled graduates leave the state for lack of desired employment opportunities.

* * *

While motivational factors bearing on this issue vary from state to state, and locality to locality, it can be concluded, based on evidence available, that educational reform keyed to "learning output" instruction would face, generally, negative teacher attitudes.

The current system, as noted earlier, offers few incentives, if any, for changing the accepted way of

doing things. Teaching, as currently taught and practiced, usually moves from theory to application of a subject, no matter what. Too often it matters little whether the student knows all or part of what the teacher intends to teach. Too often, if the student lacks prerequisite knowledge with which to understand the material being presented, remedial instruction is the only solution offered. Too often the attitude prevails: "I know my subject; therefore, I know what and how to teach."

In this operational climate, who needs objectives? So it goes, too often.

There are a number of widespread beliefs that militate against the easy adoption of the notion of objectives, of the idea that "I ought to know what I intend to achieve before spending public money trying to get there."

One of these is the belief that the teacher's function is not that of changing students in some desired manner, but rather to "actualize" the student. Actualizing means doing things to the student and expecting him to react in terms of what was inside him all the time. It is to deny the responsibility of the change agent; it is to deny the responsibility of making sound decisions about how the life of another will be influenced. With such a belief the need for objectives is nonexistent.

Another attitude suggests that the teacher believes that teaching is the same as assigning. The teacher is in charge, and makes assignments. And when he says, "I'm going to hold you responsible for so-and-so" he is, in effect, saying, "I'm not going to teach you this, but I'm going to expect you to know it." Such attitudes about the functions of the instructor again negate the importance of objectives. Why go to the trouble of defining intended outcomes when it is possible to tell the student what you want by pointing to the right chapters in the book?

Perhaps the most problematical attitude is the one that says teaching is evaluated best by looking at the teacher rather than at the performance of the student. Too often, the "good" teacher is determined by what he does rather than by what he achieves, rather than by what he accomplishes. Too often, the "good" teacher is one who holds his chalk properly, maintains discipline, speaks loudly enough to be heard, and so on.

Under such circumstances it is difficult for most teachers to see why objectives are needed. Why take the trouble to describe what you want to achieve when you already know what to teach and when you are doing a good job in the classroom?

Investigators close to the problem seem to be in agreement that the most difficult thing to accomplish with teachers is that of modifying their outlook from one that is procedure-oriented to one that is outcome-oriented. Thus, teachers generally reveal a great reluctance to accept responsibility for the outcome of their efforts. On the one hand is the belief that the teacher teaches, and, on the other hand, the contradictory attitude that the teacher really can't be held responsible for achievement, or lack of it, on the part of the student.

If this appraisal is even partially realistic, it becomes discouraging to contemplate a movement for widespread reform based on "learning output" instruction. Yet, here and there -- coming out of the woodwork, so to speak -- are growing numbers of teachers and administrators who seek change in the classroom, who are motivated toward student-centered instruction. It is these people who must be encouraged. And they need proper tools.

In searching for answers we can at least conclude:

1. Move ahead faster with criterion-referenced instruction in vocational skill areas, where measurement and validation of results -- because of the "hands on" aspects -- is more readily obtainable.

2. Make full use of existing instructional programs, such as those offered by the Air Force, which provide sets of objectives, already validated, thus eliminating the "objective-writing barrier," and replacing invention with adaptation.

Certainly no further research is needed to determine whether -- in the vocational area, at least -- criterion-referenced instruction is more effective than conventional instruction. And, by their nature, the instructional materials involved tend to minimize any negative impact an instructor might place on them in the introductory phase. Further, literature on the use of criterion-referenced materials is readily available to teachers, and is accumulating rather rapidly. However, the gap is wide between theory and practice -- between this literature and classroom experience.

This leaves one element that deserves further attention: namely, more explicit, step-by-step instructions for the teacher who is dealing for the first time with criterion-referenced materials. Such instructions should be so explicit that he will be able to tell when he is not proceeding according to design. Much basic material exists to accomplish this purpose. The instructor schools of the Air Force are a prime source.

X. RECOMMENDATION

Recommendation: That practical guidelines for teachers be formulated to implement criterion-referenced courses in vocational-skill areas, drawing fully on procedures developed and collected by the U. S. Air Force, and on other sources -- such guidelines to provide step-by-step instructions for classroom use.

XII. ABSTRACT

This report supplements Final Report (Project No. 8-0301, USOE) for the study entitled "The Evaluation of Three U. S. Air Force Instructional Systems Within Civilian Education." During that study it became evident that the Air Force materials were not being used under optimal conditions, particularly the relationship of specific performance objectives, and this gave rise to this supplemental report.

Basic guidelines for introducing criterion-referenced materials as represented by those of the Air Force, into the civilian classroom. Guidelines based on experience gained in basic research project, including interviews with administrators and instructors, and on other related experiences. Report first describes Air Force criterion-referenced materials, compares and contrasts them with conventional instruction materials. It then offers suggestions for selection, preparation for use and use of criterion-referenced materials. Teacher attitudes and orientation are also covered.

Report recommends that practical guidelines for teachers be formulated to implement criterion-referenced courses in vocational skill areas, drawing fully on procedures developed and collected by the U. S. Air Force, and on other sources.